

NDT and SHM of Carbon Fiber Composites using Linear Drive MWM-Arrays

Andrew Washabaugh, Christopher Martin, Robert Lyons, David Grundy, Neil Goldfine
JENTEK Sensors, Inc., 110-1 Clematis Avenue, Waltham, MA 02453-7013
Tel: 781-642-9666; Email: jentek@shore.net

Richard Russell
NASA Kennedy Space Center
Phone: 321-861-8618; Email: richard.w.russell@nasa.gov

Russell Wincheski
NASA Langley Research Center
Phone: 757-864-4798; Email: russell.a.winceski@nasa.gov

Abstract

Carbon fiber composites are used in a wide range of structural applications due to their excellent specific strength and stiffness. However, the anisotropic mechanical and electrical properties associated with the fibers within each composite layer present challenges, and opportunities, for Nondestructive Testing (NDT) methods used to characterize and assess the structure condition. This includes composite condition after manufacture (such as fiber orientation and density, porosity, delamination, and bond strength) and during usage (such as damage from impact, fiber breakage, thermal exposure or applied stress). Ultrasonic and thermographic methods can address some of these challenges, but eddy current methods provide an alternative method for composite structures that contain a conducting material, such as carbon fibers or a metallic liner.

This presentation reviews recent advances in the development of eddy current sensors and arrays for carbon fiber composite NDT and Structural Health Monitoring (SHM) applications. The focus is on eddy current sensor constructs with linear drive windings, such as MWM[®]-Arrays, that induce currents primarily within the linear fibers of the composite. By combining this type of sensor construct with micromechanical models that relate composite constituent properties to measurable sensor responses, insight is obtained into the volumetric distribution of electrical properties within the composite and the associated manufacturing, damage, or strain conditions. With knowledge of the fiber layup, this MWM-Array technology is able to detect damage and strain/stress as a function of depth and fiber orientation. This work has been funded by NASA, NAVAIR and the Army for applications ranging from composite overwrapped pressure vessels (COPVs) to aircraft structures and rotorcraft blades. This presentation will specifically present background on the MWM-Array technology, results from the micromechanical modeling effort, and results from ongoing efforts for high resolution imaging and volumetric strain sensing.